

REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-15 and 20-25 are presently active in this application, Claims 1, 3, 4, 6, 7 and 20 having been amended, Claims 16-19 canceled and Claims 44-60 added by the present amendment.

In the outstanding Office Action, Claims 1-4 were under 35 U.S.C. § 102(e) as being anticipated by Thapar (U.S. Patent 6,580,123); Claims 1-4, 7, 16 and 17 were under 35 U.S.C. § 102(e) as being anticipated by Kitagawa; Claims 1-4, 7, 16 and 17 were further rejected under 35 U.S.C. § 102(e) as being anticipated by Fujihara (U.S. Patent 6,720,615). However, Claims 5, 6 and 18-20 were objected to as being dependent upon a rejected base claim, but were indicated as allowable if rewritten in independent form, and Claims 8-15 were indicated as being allowable over the prior art of record.

Applicants acknowledge with appreciation the indication that claims 8-15 are allowable over the prior art of record and that Claims 5, 6 and 18-20 include allowable subject matter.

In light of this indication, claim 20 has been amended to be in independent form and is therefore also believed to be allowable.

In light of this several grounds for rejection on the merits, claim 1 has been amended to clarify the vertical stacking of the first and second semiconductor regions, thereby to more clearly distinguish over the applied prior art. To that end, amended claim 1 recites that the first semiconductor region is provided under the semiconductor base region and the second semiconductor region is provided under the first semiconductor. These changes are made

consistent with the disclosure shown in Figures 1-3 and are not believed to raise a question of new matter.

In contrast, Thapar does not disclose the vertical and alternative stack structure recited in amended claim 1. According to Thapar, under the p⁻ channel diffusion 12, a very lightly doped p⁻/n⁻ diffusion 30 and n⁻ layer 11 are stacked in this order as shown in Fig. 1A and as described at column 2, line 61 through column 3, line 24, for example. In contrast, according to amended claim 1, under the base region of a first conductivity type, a first semiconductor region of a second conductivity type and a second semiconductor region of the first conductivity type are stacked in that order.¹ That is, the conductivity type according to the claimed invention alternately changes in the vertical direction.

By virtue of the alternate change in conductivity type in the vertical direction, as stated in amended claim 1, the depleted region spreads from the p-n junction to the p-type region 10 and the n-type region 9 as shown in Fig. 2. Thus, the capacitance C_{ds} between the drain and the source and the capacitance C_{gd} between the drain and the gate can be lowered effectively by forming such a depleted region DP in the circumference of the trenches. As a result, the parasitic capacitance of the semiconductor device can be reduced and the multiplication value of 'on resistance' and 'parasitic capacitance' can be lowered, as explained at page 8, lines 9-18 of Applicants' disclosure, for example. In view of this distinction, it is respectfully submitted that amended claim 1 clearly patentably defines over the Thapar reference.

Turning now to the commonly owned Kitagawa patent, this patent discloses a structure where the p-type semiconductor regions and the n-type semiconductor regions are disposed in a lateral direction, as shown in Fig. 24, for example. Thus, it is evident that the

¹ Applicants' Figures 1 and 3, for example.

vertical structure recited in amended claim 1 is quite different from the lateral structure disclosed by Kitagawa and it is respectfully submitted that amended claim 1 patentably defines over Kitagawa.

The Fujihara reference is likewise believed to be deficient as failing to disclose the vertical and alternative stacked structure recited in amended claim 1, as is evident from Fujihara's Fig. 12B which is clearly lacking the semiconductor regions 9, 10 of alternately conductivity type shown in Applicants' Figs. 1-3. Accordingly, it is respectfully submitted that amended claim 1 further patentably distinguishes over the Fujihara patent as well as the Thapar and Kitagawa patents. Thus, it is respectfully submitted that amended claim 1 patentably distinguishes over the applied prior art of record and is in condition for allowance.

Dependent claims 3, 4, 6 and 7 have been amended to employ terminology consistent with the terminology of amended claim 1. Claims 2-7 which depend from claim 1 are also believed to be allowable.

New claim 21 is directed to the structure shown in Applicants' Fig. 17, wherein the p-type region 10 is in contact with the side of the trench gate, but is not in contact with the bottom of the trench gate, and the n-type region 11 is provided instead. Since new claim 21 depends from allowable claim 20, new claim 21 is likewise believed to be allowable.

New claim 22 is directed to the structure shown in Applicants' Fig. 19 disclosure, wherein the n-type region 9 and the p-type region 10 are provided by turns along with the two diagonal directions on the n-type epitaxial region 6. This structure is also believed to be patentably distinguishing. New claims 23-25 state features formerly recited in claims 17-19, and depend from claim 22 or claim 20, and therefore are also believed to be allowable.

Consequently, in view of the present amendment, no further issues are believed to be

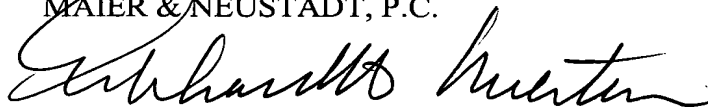
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outstanding, and the present application is believed to be in condition for formal allowance.

An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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